An update on Analysis of TexAQS 2000 Data

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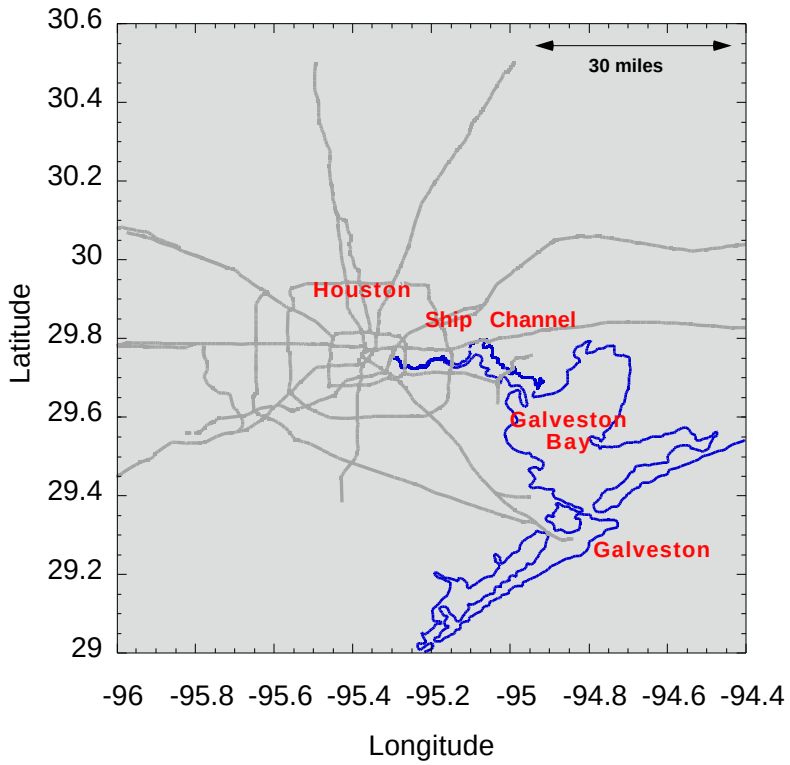
TexAQS 2000 A Major Air Quality Study

Conducted- August 15 - September 15, 2000

Study focused on Houston, but measurements made all over East Texas.

Principal Project Area



At its peak, the study included nearly 300 scientists and technicians from over 40 organizations.

Resources included 4 aircraft, TNRCC, Houston and industrial monitoring sites, 3 GC/ARCH sites, supersites at LaPorte Airport and on top of Williams Tower, and four wind profilers.

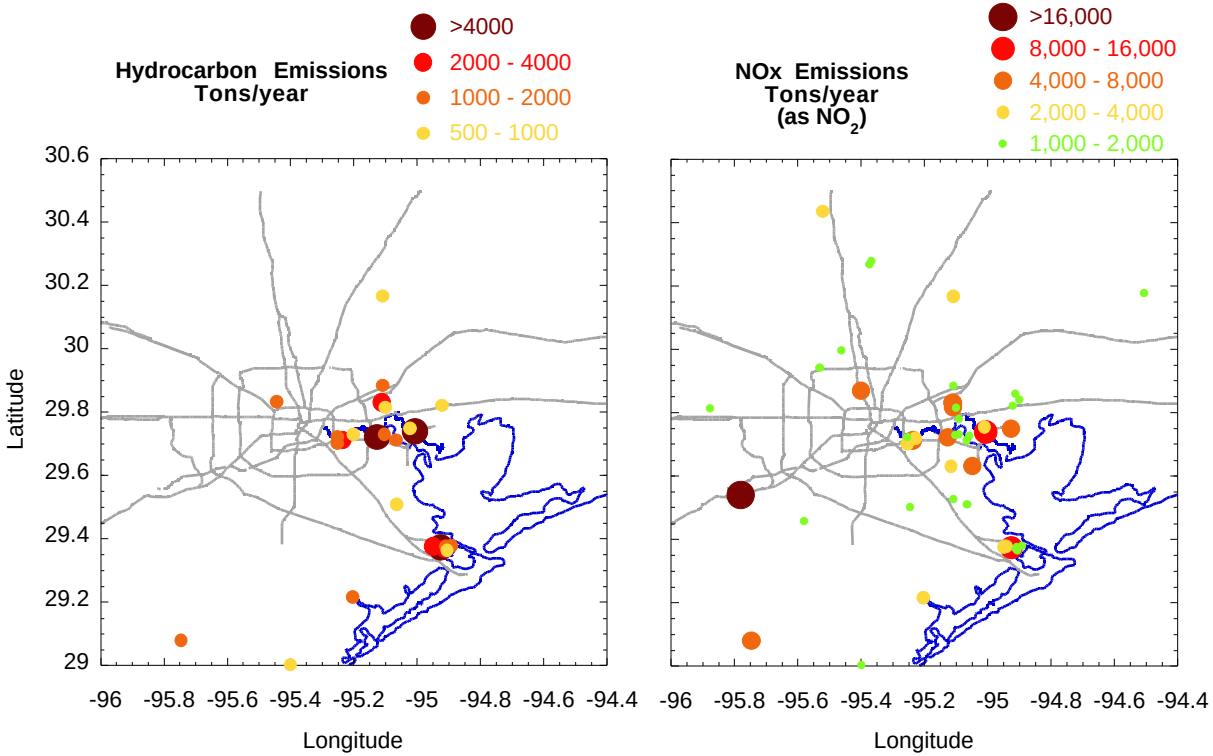
What's special about Houston?

Houston has one of the most severe ozone problems in the country and in late summer routinely violates the NAAQS 120 ppb ozone standard.

But- the Houston problem is different than it is in other cities because there are-

- *Major industrial sources of ozone precursors.*
- *Coastal circulation effects which allows the accumulation ozone and ozone precursors which can be subsequently transported anywhere in the Houston area.*

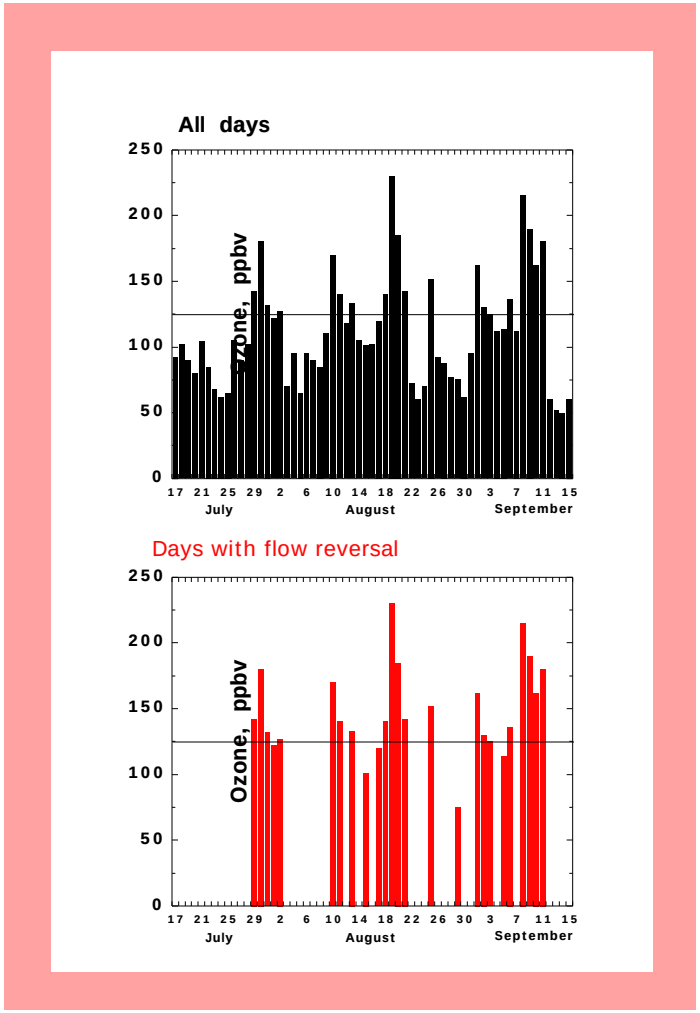
Point Sources of O_3 precursors



Major point sources of VOC and NO_x along the Houston Ship Channel and to the south near Texas City.

Coastal Circulation Effects

Almost all days on which an exceedance of the NAAQS O_3 occurred were associated with a flow reversal caused by coastal circulation effects.



TexAQS 2000 Objectives

The overall objective of this study was to provide a better understanding of the emissions, and the basic chemical, physical, and meteorological processes that determine ozone and fine particle distributions in eastern Texas with a focus on Houston.

Organizations participating included- SOS, TNRCC, NOAA Aeronomy and ETL Laboratories, DOE Atmospheric Chemistry Program, EPA GC-ARCH, NASA, City of Houston, The University of Texas and a host of additional Universities from around the country.

Sponsors included- TNRCC, DOC, DOE, EPA, EPRI, SOS and many others who contributed in kind resources or funding.

Resources

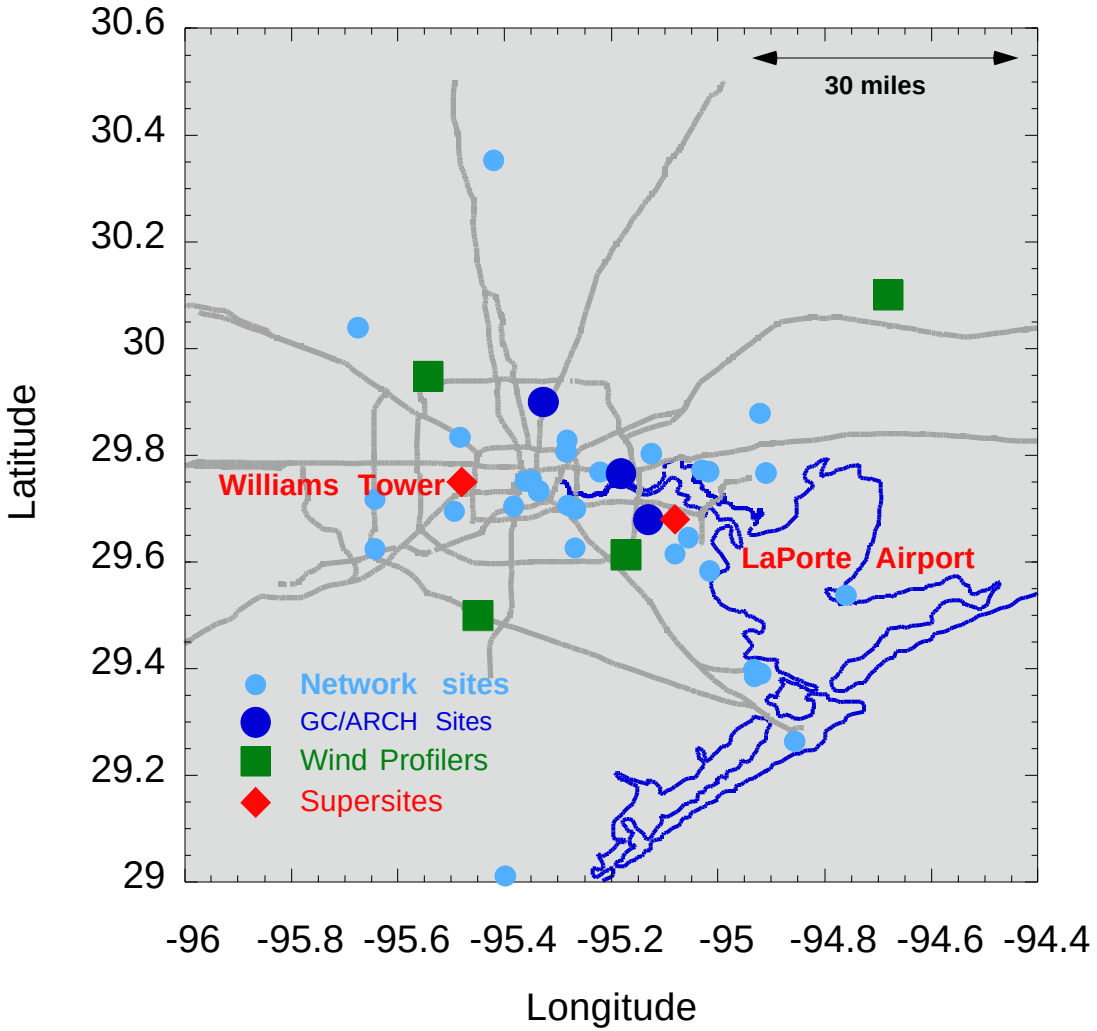
Four aircraft including- DOE G-1, NOAA/NCAR Electra, NOAA DC-3, Baylor Twin Otter.

Network sites included included sites sponsored by TNRCC, City of Houston, and local industries. Instrumentation varied extending from wind measurements only, to PAMS type measurements.

GC/ARCH sites part of the EPA aerosol supersites program, and were operated by the University of Texas.

"Supersites" at Laporte Airport (NOAA), and on the 68th floor of Williams Tower (DOE).

Surface Network



Accomplishments

Most detailed characterization that has ever been done of the sources, transformation processes and meteorology controlling ozone and aerosol concentrations in a major urban area.

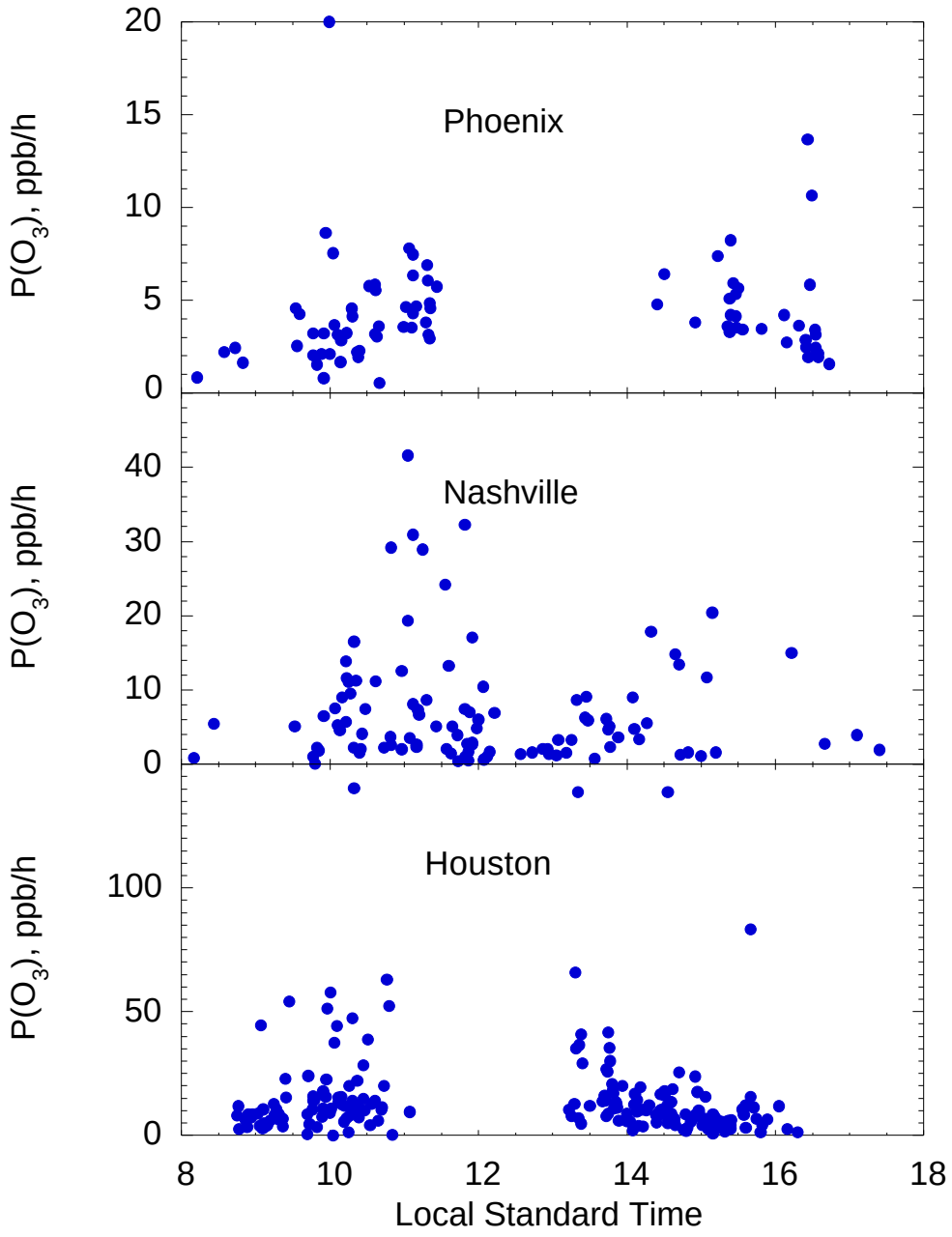
Ideal conditions for an air quality study!!

- *O_3 concentrations almost routinely in excess of 120 ppbv.*

- *Major episode in late August early September*

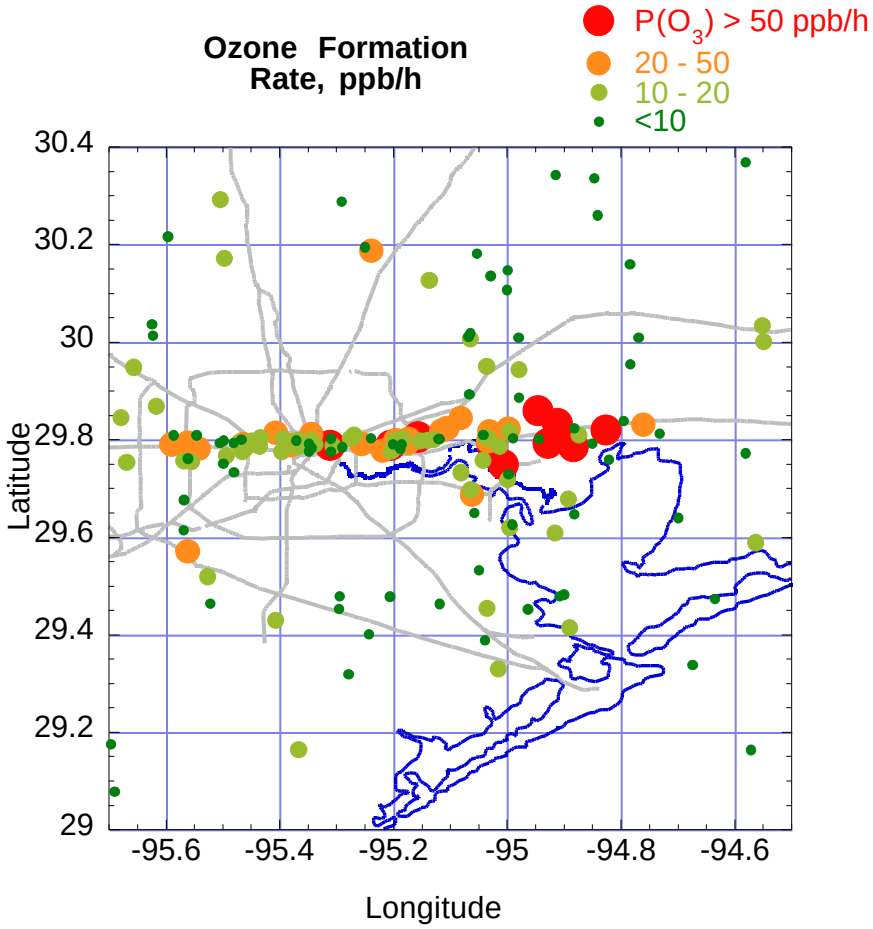
Major Findings

- *Instantaneous O_3 formation rates in Houston are the highest we have observed in any of the urban areas we have studied in the last decade.*



Major Findings

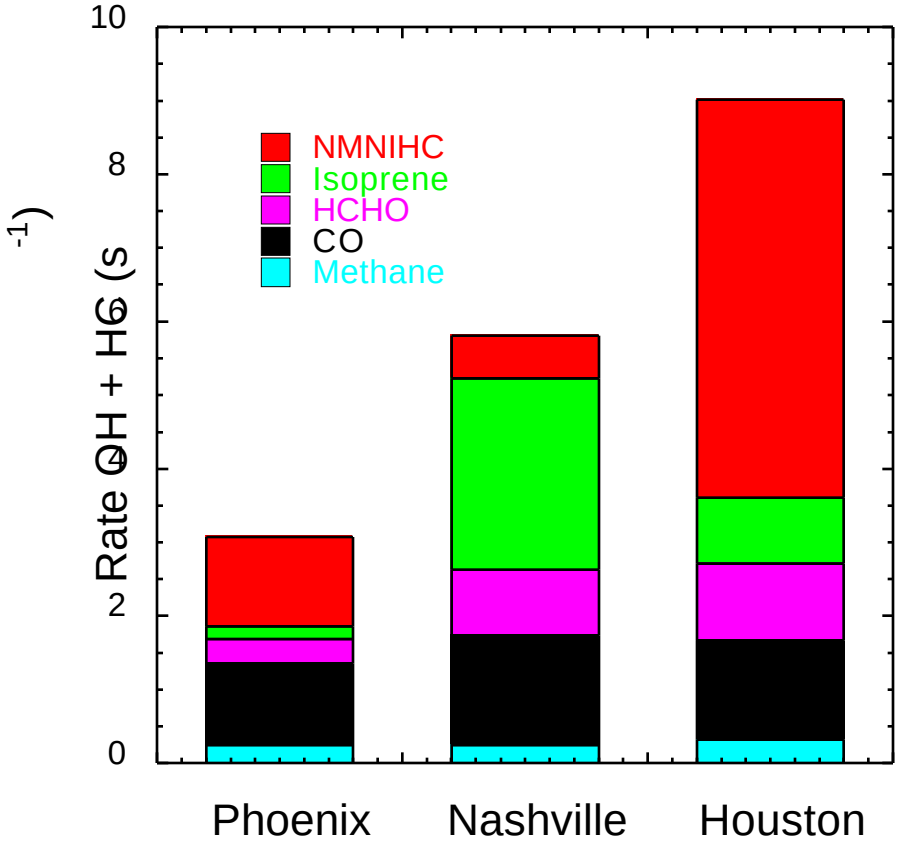
- *The highest values of $P(O_3)$ are observed in the vicinity of the Houston Ship Channel.*
- *These high O_3 formation rates are driven by high concentrations of anthropogenic hydrocarbons.*



Geographic distribution of $P(O_3)$ from G-1 measurements.

Major Findings

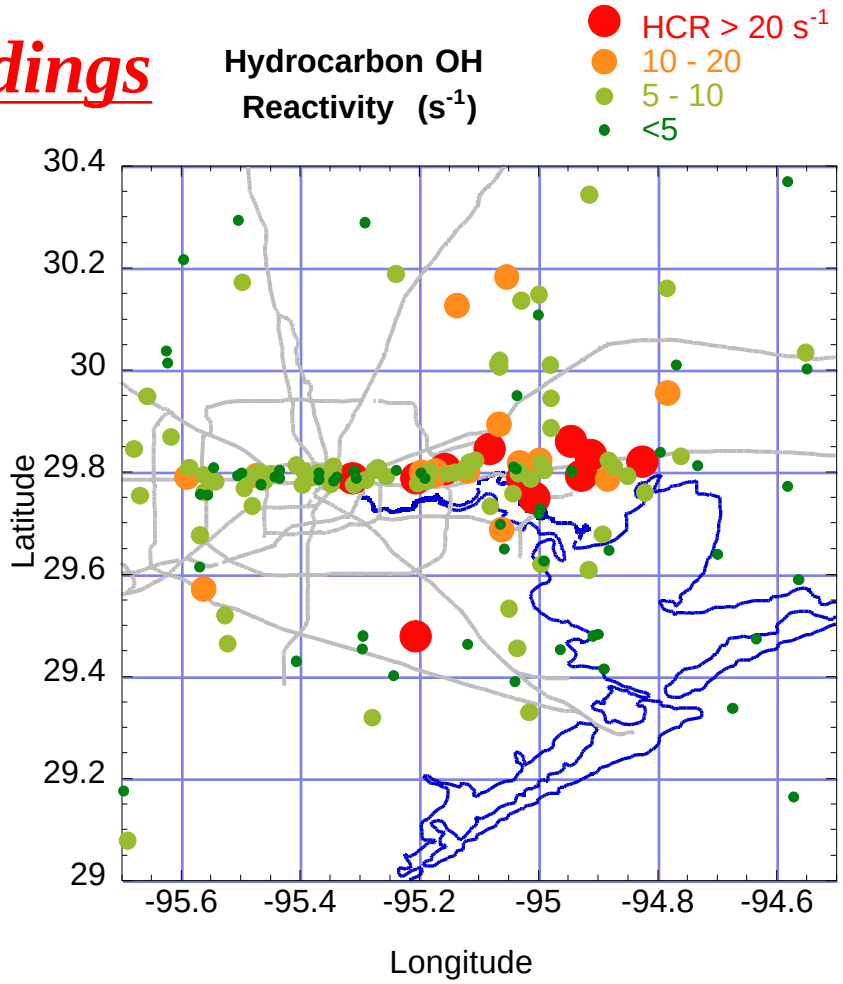
•Hydrocarbon reactivities are typically much higher in Houston than in other urban areas in the US and these high hydrocarbon reactivities are dominated by anthropogenic hydrocarbons. Biogenic hydrocarbons appear to make only a minor contribution to the reactivity.



Mean hydrocarbon reactivities from all G-1 measurements.

Major Findings

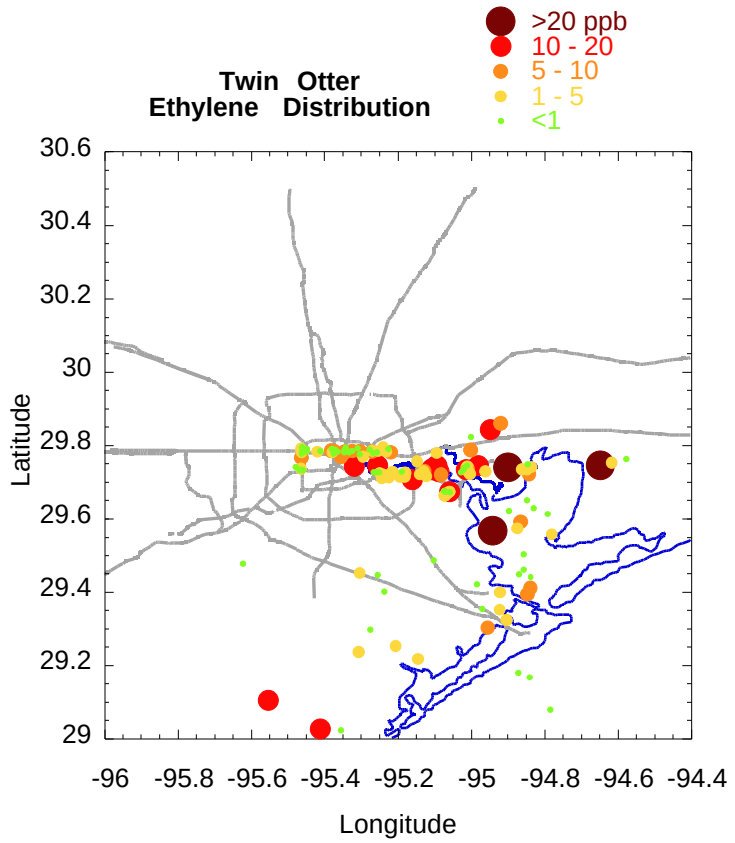
- *Industries in and around the Houston Ship Channel appear to be a major source of hydrocarbons for ozone formation*



Geographic distribution of hydrocarbon reactivity from all G-1 measurements.

Major Findings

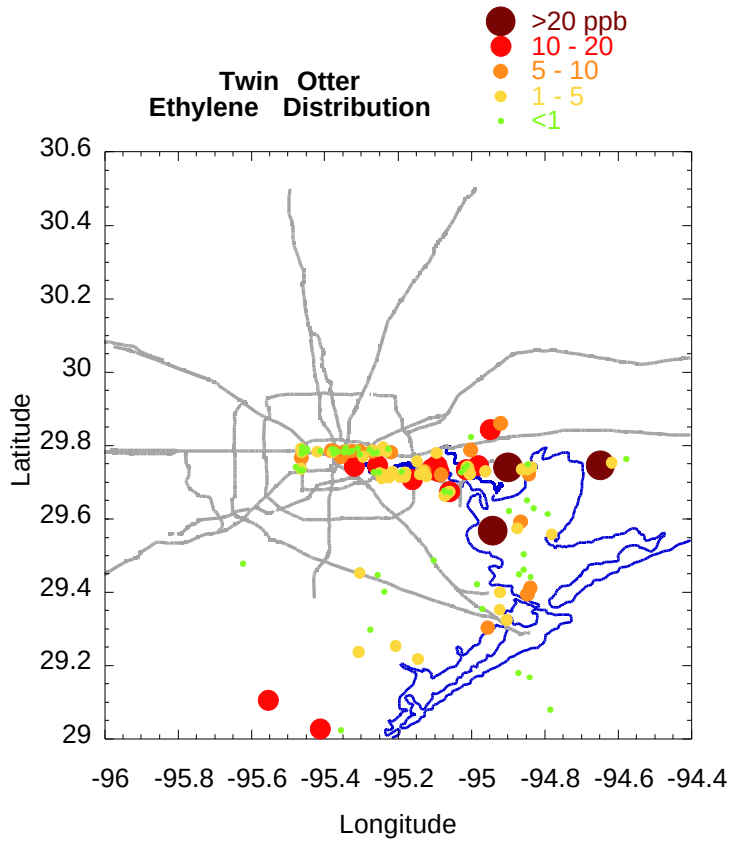
•Low molecular weight alkenes (propene, ethylene and isobutene) appear to be a major source of hydrocarbon reactivity for ozone formation.



Geographic distribution of ethylene concentrations from all Twin Otter measurements.

Major Findings

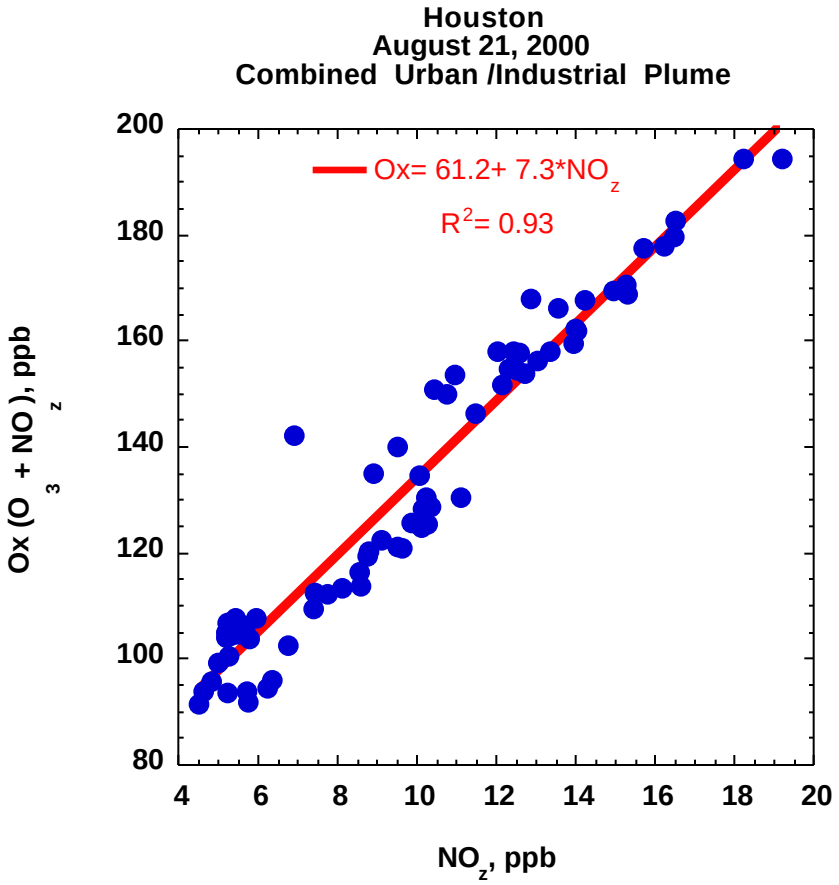
•Low molecular weight alkenes (propene, ethylene and isobutene) appear to be a major source of hydrocarbon reactivity for ozone formation.

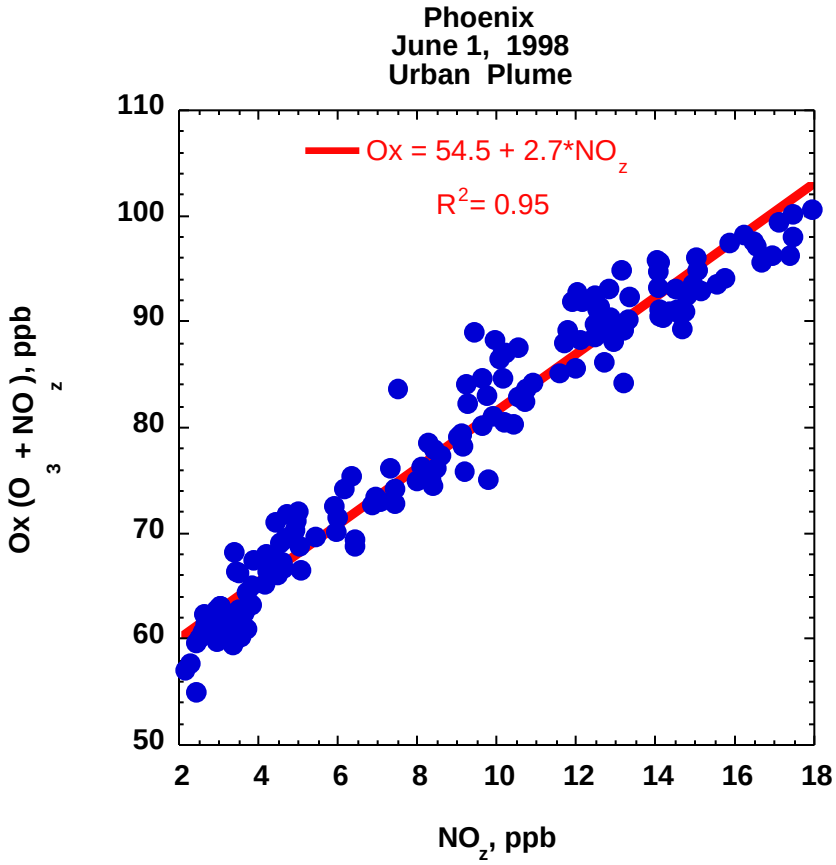


Geographic distribution of ethylene concentrations from all Twin Otter measurements.

Major Findings

•*Ozone formation in the Houston urban/industrial plume is more efficient than in such plumes elsewhere in the US.*



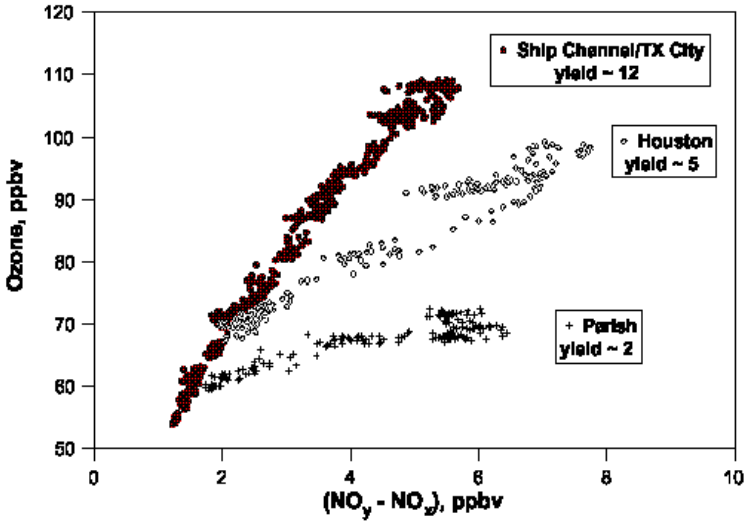


Major Findings

•*Ozone is formed more rapidly and more efficiently in plumes from industrial facilities in the Houston area than in either the Houston urban plume or in local power plant plumes.*

Ozone yield comparison
Electra data, August 28, 2000

• plumes characterized by $(NO_x/NO_y) = 0.20$

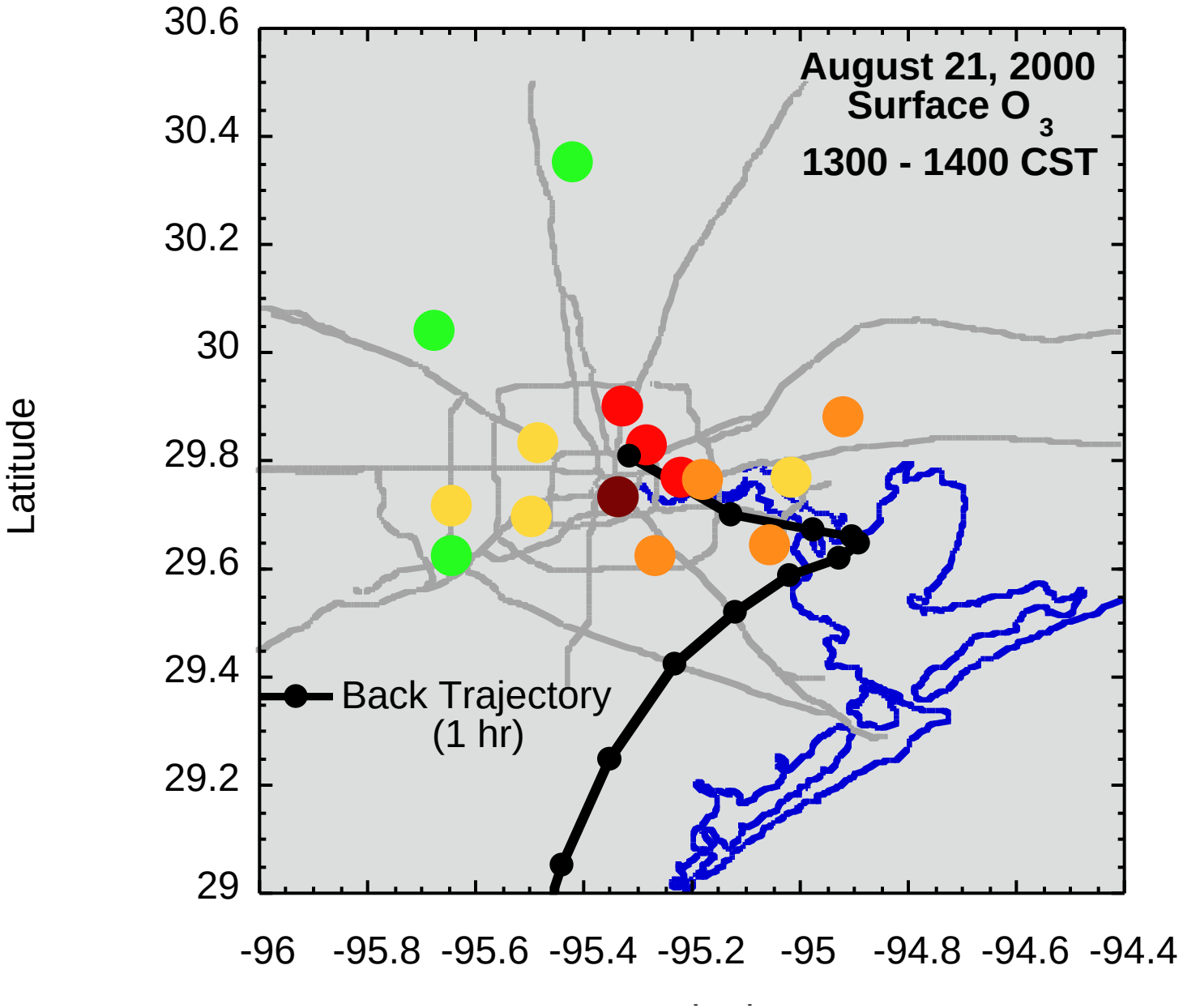


- Coalesced Ship Channel/TX City ozone yield similar to those derived in isolated petrochemical plumes on the same day
- No reported upsets at these times; interpreted as "business as usual" for both days
- Large co-located emissions of reactive alkenes and NOx consistently result in *rapid* and *efficient* ozone formation downwind

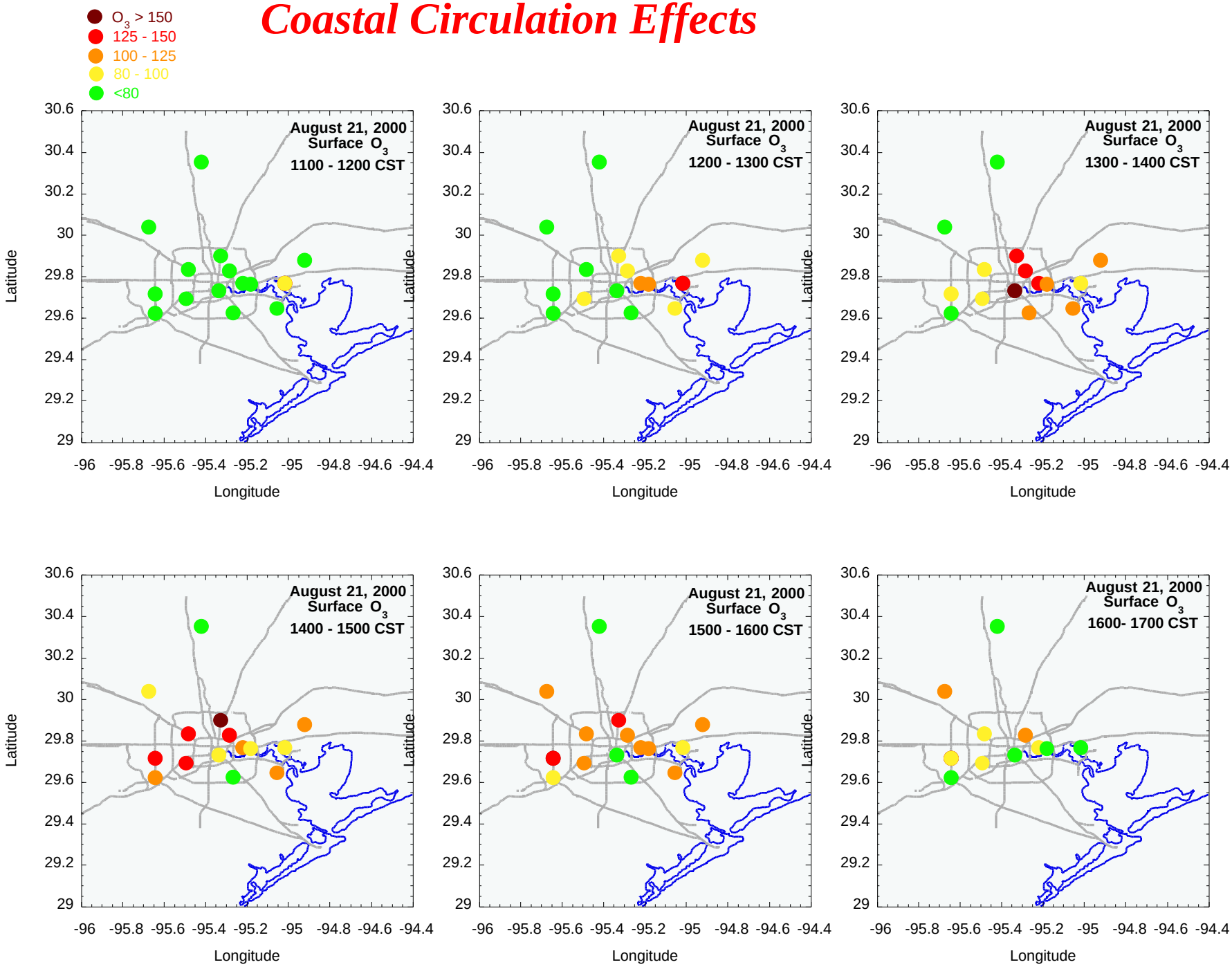
Major Findings

- *Land/sea breeze circulation effects have an important role in the accumulation of O_3 and O_3 precursors, and the location of O_3 exceedances in Houston metropolitan area.*
- *Conditions under which the highest O_3 concentrations occur are-*
  - *Offshore flow early in the morning (winds SW or W)*
  - *A period of stagnation near mid-day*
  - *A period of weak onshore flow (winds S to E depending on synoptic conditions)*

Coastal Circulation Effects

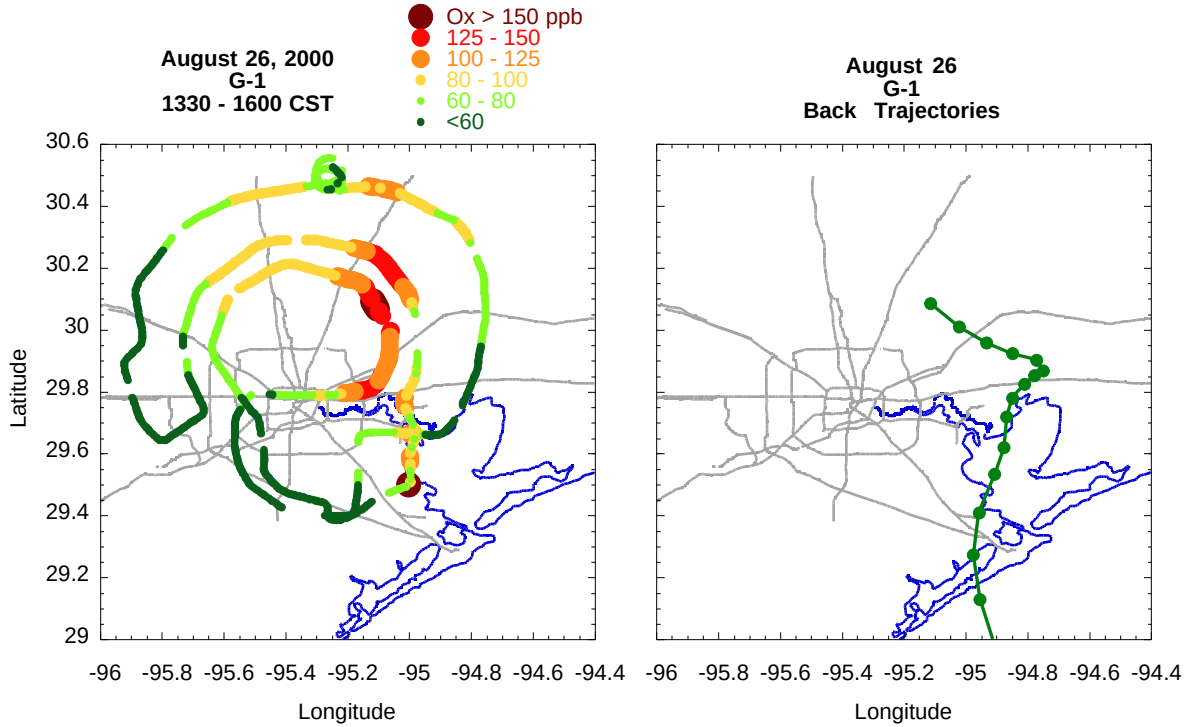


Coastal Circulation Effects



Major Findings

•*Back trajectory analysis indicates a strong linkage between O_3 plumes exceeding the NAAQS for O_3, and emissions from the industrial facilities in/around the Houston Ship channel.*



Back trajectory from peak O_3 on G-1 Flight of 8/26/2000.

Summary

- *Hydrocarbon reactivities are typically much higher in Houston than in other urban areas in the US and these high hydrocarbon reactivities are dominated by anthropogenic hydrocarbons. Biogenic hydrocarbons appear to make only a minor contribution to the reactivity.*
- *Industries in and around the Houston Ship Channel appear to be a major source of hydrocarbons for ozone formation.*
- *Low molecular weight alkenes (propene, ethylene and isobutene) appear to be a major source of hydrocarbon reactivity for ozone formation.*

Summary

- *Ozone is formed more rapidly and more efficiently in plumes from industrial facilities in the Houston area than in either the Houston urban plume or in local power plant plumes. And are typically much higher than in other urban areas.*

- *Land/sea breeze circulation effects have an important role in the accumulation of O_3 and O_3 precursors, and the location of O_3 exceedances in Houston metropolitan area.*

- *Back trajectory analysis indicates a strong connection between O_3 plumes exceeding the NAAQS for O_3, and emissions from the industrial facilities in/around the Houston Ship channel.*